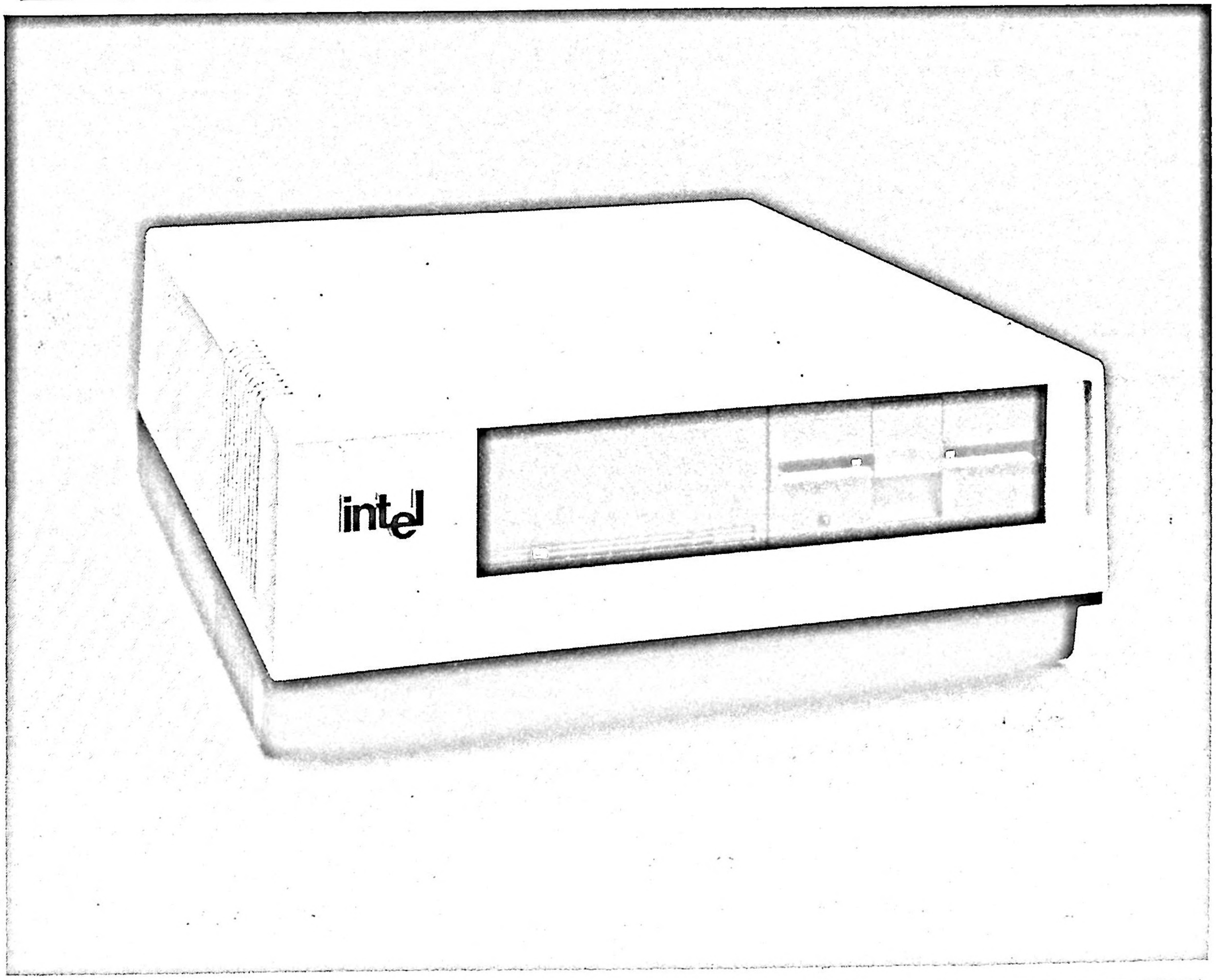
intel®

SYSTEM 310
HARDWARE INTEGRATION GUIDE



Intel Corporation, 3065 Bowers Avenue, Santa Clara, California 95051

Order Number: 173203-001

SYSTEM 310
HARDWARE INTEGRATION GUIDE

Order Number: 173203-001

Intel Corporation, 3065 Bowers Avenue, Santa Clara, California 95051

Additional copies of this manual or other Intel literature may be obtained from:

Literature Department
Intel Corporation
3065 Bowers Avenue
Santa Clara, CA 95051

Printed in USA/IS-035/5.5k/1083/WCP
OEM Systems

REV.	REVISION HISTORY	DATE
-001	Original issue	10/83

CAUTION

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for Class A Computing Device pursuant to Subpart J of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user, at his own expense, will be required to take whatever measures may be required to correct the interference.

This guide presents the information needed to successfully integrate hardware into a System 310. This information is aimed at the system designer whose primary interest is in choosing off-the-shelf MULTIBUS® boards and using them in a preconfigured System 310.

This book presents three kinds of information that can help you customize your system. It describes the contents of preconfigured systems, explains how to choose compatible hardware, and details how to remove and install hardware. Since this book describes only the hardware, you may also find it helpful to read the *Introduction to the System 310 Microcomputer* for an overview of both the hardware and the software in the System 310.

THE CHAPTERS AT A GLANCE

Chapter 1 - Overview of Preconfigured Systems
Provides a block diagram of the typical system. Lists the specific hardware in each preconfigured system.

Chapter 2 - Parts of the Chassis
Presents greater detail about parts that are common to all systems from the list in Chapter 1. Describes their function and location in the chassis.

Chapter 3 - Calculating System Compatibility
Helps you reconfigure your system by discussing the mechanical, the electrical, and the operational characteristics of the System 310.

Chapter 4 - Adding Compatible Products
Lists the pros and cons of using particular MULTIBUS products in the System 310.

Chapter 5 - Installing and Removing Parts
Provides step-by-step instructions and illustrations for installing and removing parts in the chassis.

Appendix A - System Specifications
Lists the detailed mechanical and electrical specifications for a typical preconfigured System 310.

RELATED PUBLICATIONS

The following documents contain additional information about the System 310:

System 310 Publications Guide, Order Number 173441

Introduction to the System 310 Microcomputer, Order Number 173202

System 310 Installation and Operation Guide, Order Number 173211

System 310 Processor Configuration Guide: iSBC® 86/30 Single Board Computer, Order Number 173205

System 310 Processor Configuration Guide: iSBC 286/10 Single Board Computer, Order Number 173442

System 310 Memory Configuration Guide: 86-Based Systems, Order Number 173206

System 310 Memory Configuration Guide: 286-Based Systems, Order Number 173443

System 310 Disk Configuration Guide, Order Number 173207

System 310 Hardware Maintenance Manual, Order Number 173208

System 86/300 Series Diagnostic Software User's Guide, Order Number 173477

The following manuals contain detailed information on certain components of the System 310:

iSBC 86/14 and iSBC 86/30 Single Board Computer Hardware Reference Manual, Order Number 144044

iSBC 286/10 Single Board Computer Hardware Reference Manual, Order Number 146271

iSBC 012B Technical Manual, Order Number 112748

iSBC 028CX/056CX/012CX RAM Boards Hardware Reference Manual, Order Number 145158

iSBX™ 218A Flexible Disk Controller Hardware Reference Manual, Order Number 121583

iSBC 215 Generic Winchester Controller Hardware Reference Manual, Order Number 144780

i213A 5¼" Winchester Disk Data Separator Hardware Reference Manual, Order Number 133144

The following documents contain information on general subjects related to the System 310:

Guide to Configuring MULTIBUS-Based Systems, Order Number 144788

MULTIBUS Handbook, Order Number 210883

OEM Systems Handbook, Order Number 210941

Intel MULTIBUS Specification, Order Number 980683

United States customers may obtain service and repair assistance by contacting the Intel Product Service Center in Phoenix, Arizona. Customers outside the United States should contact their sales source (Intel Sales Office or Authorized Distributor) for service information.

Before calling the Product Service Center you should have the following information:

- The date you received the product.
- The complete part number (including the dash number) of the product. This number is usually silk-screened onto printed circuit boards and stamped on the label of other products.
- The serial number of the product. This is usually silk-screened onto printed circuit boards and stamped on the label of other products.
- Your shipping and billing addresses.
- A purchase order number for billing purposes if your Intel product warranty has expired.
- Extended warranty agreement information, if applicable.

SERVICE AND REPAIR ASSISTANCE

Use the following telephone numbers to contact the Intel Product Service Marketing Administration group:

Regional Telephone Numbers		TWX Numbers
Western Region	(602) 869-4951	910-951-1330
Midwestern Region	(602) 869-4392	910-951-0687
Eastern Region	(602) 869-4045	
International	(602) 869-4391	

Always contact the Intel Product Service Marketing Administration group before returning a product to Intel for repair. When you make the request you will be given a repair authorization number, shipping instructions, and other information that will help Intel provide you with fast, efficient service.

If you are returning a product because of damage sustained during shipment or if the product is out of warranty, a purchase order is required before Intel can initiate repair.

Use the original factory packaging material in preparing a product for shipment to the repair center. If that material is not available, ensure the product is adequately protected by wrapping it in cushioning material before enclosing it in a heavy-duty corrugated shipping carton. All cartons should be labeled "FRAGILE" to ensure careful handling. If a printed circuit board is being returned, a material such as Air Cap TH-240, manufactured by the Sealed Air Corporation of Hawthorne, New Jersey, should be used to give adequate cushioning.

Address and ship only to the address specified by Intel Product Service Marketing Administration group personnel.

CONTENTS

CHAPTER 1 OVERVIEW OF PRECONFIGURED SYSTEMS	PAGE
Block Diagram of the System	1-2
Standard System 310 Configurations	1-3
Three 86-Based Configurations	1-3
System 310-1 Configuration-Specific Hardware	1-3
System 310-2 Configuration-Specific Hardware	1-4
System 310-3 Configuration-Specific Hardware	1-4
Two 286-Based Configurations	1-4
System 310-4 Configuration-Specific Hardware	1-4
System 310-5 Configuration-Specific Hardware	1-4
Configuring Your Own System 310 Hardware	1-5

CHAPTER 2 PARTS OF THE CHASSIS	
The Outside of the Chassis	2-1
Back Panel and Connectors	2-1
Serial and Parallel I/O Connectors	2-1
AC Power Panel	2-2
The Inside of the Chassis	2-3
Fans	2-3
Power Supply	2-5
Cardcage and Backplane	2-5

CHAPTER 3 CALCULATING SYSTEM COMPATIBILITY	
Using Parts that Fit	3-1
Disk Drives	3-1
I/O Connectors	3-2
Circuit Boards	3-2
Electrical Compatibility	3-2
Calculating DC Power Requirements	3-3
Operating Compatibility	3-6
Addressing	3-6
System Interrupts	3-6
Bus Contention	3-6
Board Placement Guidelines	3-7

CHAPTER 4
ADDING COMPATIBLE PRODUCTS
Compatible Processor Boards 4-1
Adding Expansion Boards on the Processor
Boards 4-2
Compatible Disk Controllers 4-3
Compatible Tape Controllers 4-4
Compatible Memory Boards 4-5
Compatible Communication Controllers 4-6

CHAPTER 5
INSTALLING AND REMOVING PARTS
Changing Hardware Without Removing the Cover 5-1
Changing the Fuse and Voltage Selector 5-1
Equipment You Will Need 5-2
Steps 5-2
Removing and Installing the Back Panel 5-4
Equipment You Will Need 5-4
Removing the Back Panel 5-4
Connecting the Cables 5-4
Installing the Back Panel 5-7
Changing Hardware Inside the Chassis 5-7
Removing and Installing the Top Cover 5-8
Equipment You Will Need 5-8
Removing the Top Cover 5-8
Installing the Top Cover 5-9
Changing the Jumpers on the Backplane 5-9
Interrupt Jumpers 5-9
Priority Jumpers 5-10

APPENDIX A
SYSTEM SPECIFICATIONS

INDEX

TABLES

TABLE	TITLE	PAGE
3-1	220-Watt Power Supply Specifications	3-2
3-2	Maximum DC Power Consumption	3-3
3-3	DC Power Consumed by Each System	3-5
4-1	Compatible Processor Boards	4-2
4-2	Compatible Expansion Boards	4-3
4-3	Compatible Disk Controllers	4-4
4-4	Compatible Tape Controllers	4-5
4-5	Compatible Memory Boards	4-5
4-6	Communication Controllers	4-6
5-1	Priority of the Card Slots	5-11

FIGURES

FIGURE	TITLE	PAGE
1-1	A System 310 Configuration	1-1
1-2	Block Diagram of the System 310	1-2
2-1	System 310 Back Panel and AC Power Panel	2-2
2-2	Inside View of a System 310	2-4
5-1	Changing the Fuse and Voltage Selector	5-2
5-2	Drive Cables Viewed from the Cardcage	5-5
5-3	Connecting the Winchester Disk Drive Cables	5-6
5-4	Mounting Screws for the Top Cover	5-8
5-5	Jumper Locations on the Backplane	5-10
5-6	Choosing New Card Slot Priorities	5-12

CHAPTER 1
OVERVIEW OF PRECONFIGURED SYSTEMS

The System 310 is one of Intel's open systems. Open systems are easy to configure and use standard parts, which means you can easily customize them. To create a customized version of the System 310, you simple change compatible software, circuit boards, peripherals, or MULTIMODULE™ boards in any one of the standard configurations. Figure 1-1 shows one way you might configure the System 310.

To help you understand more about your system, this chapter provides an overview of system hardware modules. A block diagram (Figure 1-2) illustrates how these modules interrelate to construct a system. Following the diagram are lists of the specific hardware found in each preconfigured System 310. These lists show the particular hardware product Intel uses to provide each system function shown in the diagram.

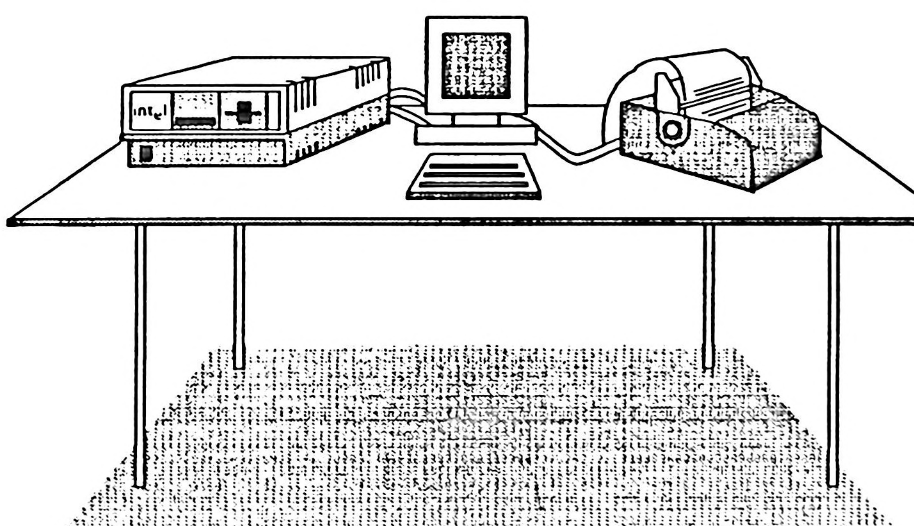
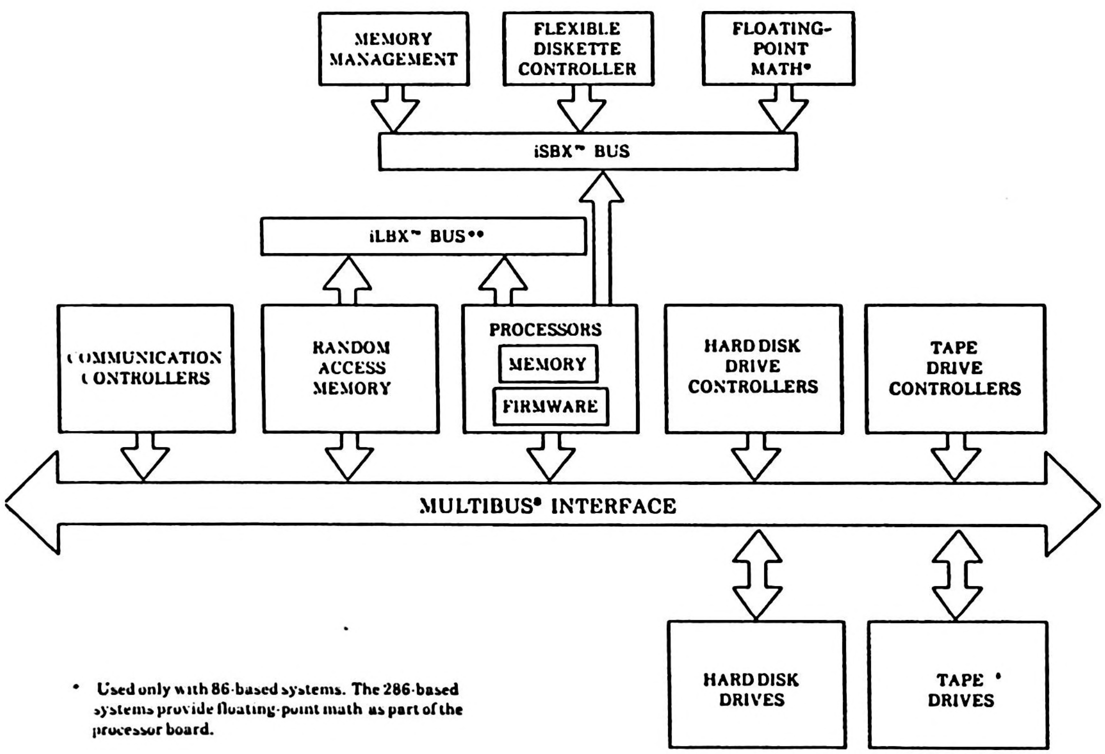


Figure 1-1. A System 310 Configuration F-0153

BLOCK DIAGRAM OF THE SYSTEM

The System 310, like all computer systems, consists of hardware modules. Each module represents one or more pieces of hardware that perform a similar task, such as memory boards or drive controllers. Figure 1-2 shows the hardware modules in the System 310 so you can easily see where each System 310-compatible product fits into the structure.

You can purchase the products that make up hardware modules as part of a standard configuration, already installed and integrated into a System 310, or you can purchase these products separately and integrate them yourself. When you are ready to substitute specific hardware for these modules, refer to Chapter 5. It names all the circuit boards that you can use to perform each task and provides guidelines for integrating them into a System 310.



* Used only with 86-based systems. The 286-based systems provide floating-point math as part of the processor board.

** Used only with 286/10 processors.

Figure 1-2. Block Diagram of the System 310 F-0124

As an example of how to use the block diagram, suppose you want to add a processor board to your system. First, you would find the block labeled "Processors" in the diagram. You can see that you must choose a MULTIBUS-compatible board because Figure 1-2 shows the processor module connected to the MULTIBUS® interface. You also see that processors can communicate with any other module connected to this bus. Other boards can communicate with the processor over two additional buses: the iLBX™ bus (286/10 processors only) and the iSBX™ bus. In addition, the processor may contain firmware and on-board memory.

To chose a specific board, refer to Chapter 5 in this manual. Chapter 5 tells you that the processor block may be either the iSBC® 86/30 Single Board Computer or the iSBC 286/10 Single Board Computer. Furthermore, it lists the names of all the iSBX expansion boards that are compatible with each processor.

STANDARD SYSTEM 310 CONFIGURATIONS

Intel offers several preconfigured versions of the System 310. Each one contains many of the hardware modules in Figure 1-2. These systems fall into two categories, based on the kind of processor they contain. Specifically, three configurations are designed around the 8086 microprocessor; two others are designed around the 80286 microprocessor.

THREE 86-BASED CONFIGURATIONS

The three 86-based configurations of the System 310 share several features. They are:

- 7-slot MULTIBUS cardcage
- 86/30 processor board
- RS-232 serial port
- Parallel port for a Centronics*-type printer interface
- 5¼-inch flexible diskette drive and controller
- 220-watt switching power supply

In addition to this hardware, common to each preconfigured system, each preconfigured version also contains configuration-specific hardware which appears in the following lists. In general, the preconfigured systems differ by the number of unused card slots, the amount of Random Access Memory (RAM), the type of disk storage provided, and the presence or absence of hardware support for floating-point math.

System 310-1 Configuration-Specific Hardware

- 6 unused card slots
- 128K bytes of RAM

*Centronics is a trademark of Centronics Data Computer Corporation.

System 310-2 Configuration-Specific Hardware

- 5 unused card slots
- 256K bytes of RAM
- 1 10M-byte, 5¼-inch Winchester hard disk drive and controller
- 1 8087 floating-point math coprocessor

System 310-3 Configuration-Specific Hardware

- 4 unused card slots
- 640K bytes of memory
- 1 10M-byte, 5¼-inch Winchester hard disk drive and controller
- 1 8087 floating-point math coprocessor

TWO 286-BASED CONFIGURATIONS

Two preconfigured systems are designed around the 80286 microprocessor. The 80286 enhances the speed of the system and has more software commands than the 86-based systems. The 286-based systems, like the 86-based systems, share features. They are:

- 7-slot MULTIBUS cardcage
- 286/10 processor board
- 2 RS-232 serial ports
- Parallel port for a Centronics-type printer interface
- 512K bytes of error-correcting RAM using the iLBX bus
- 5¼-inch flexible diskette drive and controller
- 80287 floating-point math coprocessor (available soon)
- 220-watt power supply

As in the previous section ("Three 86-Based Configurations") this section points out the configuration-specific hardware that, when added to the list of hardware appearing above, makes up each 286-based System 310 configuration. The differences between these two configurations are the number of unused card slots they provide and the presence or absence of a Winchester hard disk drive. The configuration-specific hardware for each system is listed below.

System 310-4 Configuration-Specific Hardware

- 5 unused card slots

System 310-5 Configuration-Specific Hardware

- 4 unused card slots
- 1 10M-byte, 5¼-inch Winchester hard disk drive and controller

CONFIGURING YOUR OWN SYSTEM 310 HARDWARE

The System 310 is designed to be reconfigured. While Intel offers preconfigured versions of the System 310 hardware, you can change any of them by adding parts to or removing parts from the System 310 chassis.

The chassis encloses all the System 310 hardware. It provides extra card slots, a large power supply, and many precut connector mounting holes. You can add most MULTIBUS-compatible boards and many peripherals comfortably, without giving up one feature to gain another, and without violating FCC and other similar radio frequency and electromagnetic interference (RFI/EMI) regulations.

Many features you will want to use in the System 310 are available as kits from Intel and other manufacturers. Intel kits provide installation and operation instructions. In many cases, this kit information and the information in this manual are all you will need to integrate new products into your system.

Even though integrating hardware into the System 310 is very simple, Intel maintains a trained staff of Field Applications Engineers (FAEs) to help you design with Intel parts. If you have any trouble integrating hardware after reading this manual, call your local FAE for assistance. If you attempt to incorporate any Intel product that is not listed in this manual, you should call the FAE *before* you start. You can find your FAE by contacting an Intel sales office in your area. Sales offices are listed in all Intel product catalogues.

The chassis is the center of the System 310. It contains hardware, such as the on/off switch and power supply, that you must operate every time you use the system. Furthermore, the chassis contains circuit boards and jumpers that you may add, remove, or modify to customize your system.

The chapter is divided into two sections, the outside and the inside, which correspond to the hardware mounted on the outside of the chassis and the hardware mounted inside the chassis. By understanding the location and function of each part, you may be more comfortable performing hardware changes to your own system.

THE OUTSIDE OF THE CHASSIS

This section focuses on the parts of the chassis you can see and modify without having to open up the system or take any special precautions. The parts are:

- Back panel and connectors
- AC power panel

BACK PANEL AND CONNECTORS

The back of the System 310 chassis consists of a sheetmetal plate called the back panel and an AC power panel, both shown in Figure 2-1. You must remove the back panel whenever you add, remove, or modify circuit boards.

The back panel has 24 knockouts designed to fit the various connectors commonly used to communicate with peripherals and with other systems. Chapter 3 lists the kinds of connectors you can install in these knockouts.

Serial and Parallel I/O Connectors

Two connectors, labeled J20 and J24 in Figure 2-1, are already installed in the back panel of every System 310. (The 286-based systems include an additional RS-232 connector in J21.) The male connector in J20 is the RS-232 serial port from the processor board. The female connector in J24 is the Centronics-type parallel port, also from the processor board. When you expand the number of I/O ports by adding communications boards (and their cables), you must also install the new connectors in one or more of these sites. Figure 2-1 shows the location of each knockout and the type of connector it was designed to fit.

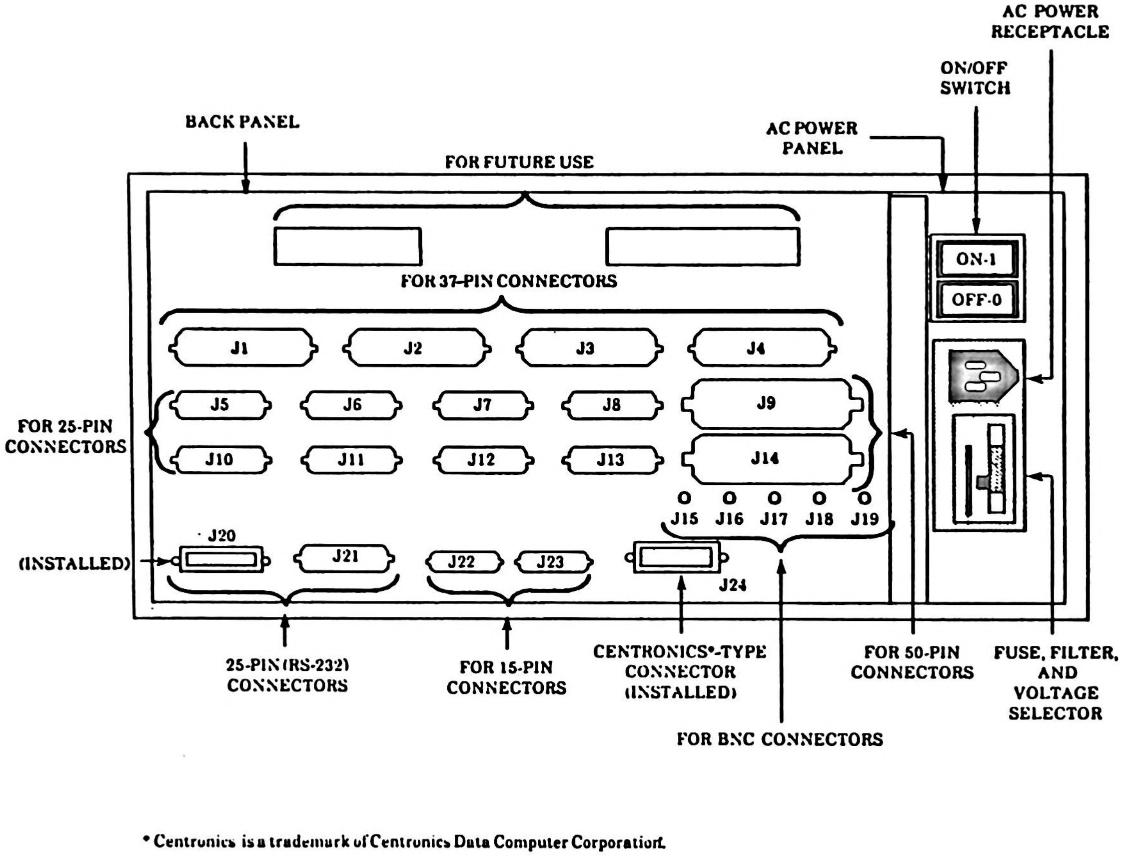


Figure 2-1. System 310 Back Panel and AC Power Panel F-0074

AC POWER PANEL

To the right of the back panel is a smaller panel containing the system on/off switch, the AC power receptacle, the line filter and fuse, and the voltage selector. Figure 2-1 shows the location of these parts.

You supply AC current to the system through the AC power panel by plugging the power cord into the receptacle. Once connected, pressing the on/off switch turns the system and the drives on.

The amount of AC current you supply must be compatible with the amount of AC current the system was set up to handle. The fuse and voltage selector are preset by the factory, so your system must use 120 volts of AC current (VAC). This setting is marked on a label located on the back or the underside of the chassis.

If your system will be using AC current rated differently from the setting indicated on the label, you can easily change these default settings. Chapter 5 in this manual contains directions for changing the voltage selector and the fuse. Whenever you change the voltage setting, be sure to also replace the power cord with one designed for the fixtures in your area.

The only parts of the AC power panel you should ever have to change are the fuse, voltage selector board, and power cable. If the AC line filter needs service, refer to the *System 310 Hardware Maintenance Manual* for repair and replacement instructions.

THE INSIDE OF THE CHASSIS

This section describes the location and function of three pieces of hardware that are found inside every System 310 chassis. You reach these parts by removing the back panel or cover. The parts covered in this section are listed below:

- Fans
- Power supply
- Cardcage and backplane

WARNING

> Because of the risk of electrical shock or fire, only qualified service technicians should attempt to remove the cover of the chassis.

The parts inside the chassis are shown in Figure 2-2. While operators can safely change boards in the cardcage when the system is unplugged, the rest of the parts shown in this figure should be changed only by a qualified service technician. The figure is included so you do not have to open the chassis to see inside.

Refer to Chapter 5 in this manual for instructions on how to install or remove boards in the cardcage and jumpers on the backplane. For repair and replacement information, refer to the *System 310 Hardware Maintenance Manual.*

FANS

The System 310 contains two fans mounted on the inside of the chassis. One cools the power supply and peripherals; the other cools the cards in the cardcage. To keep your system from overheating, always operate it with the top cover on and all connector and peripheral installation holes plugged. Only the vents in the chassis cover should remain open.

The ±12-volt DC line, routed through the backplane at the rear of the cardcage, powers both fans. They are switched on and off by the system's AC power switch so they operate whenever the System 310 is running.

The fans are designed to cool any hardware configuration that meets the electrical specifications of the system and, therefore, never need to be upgraded.

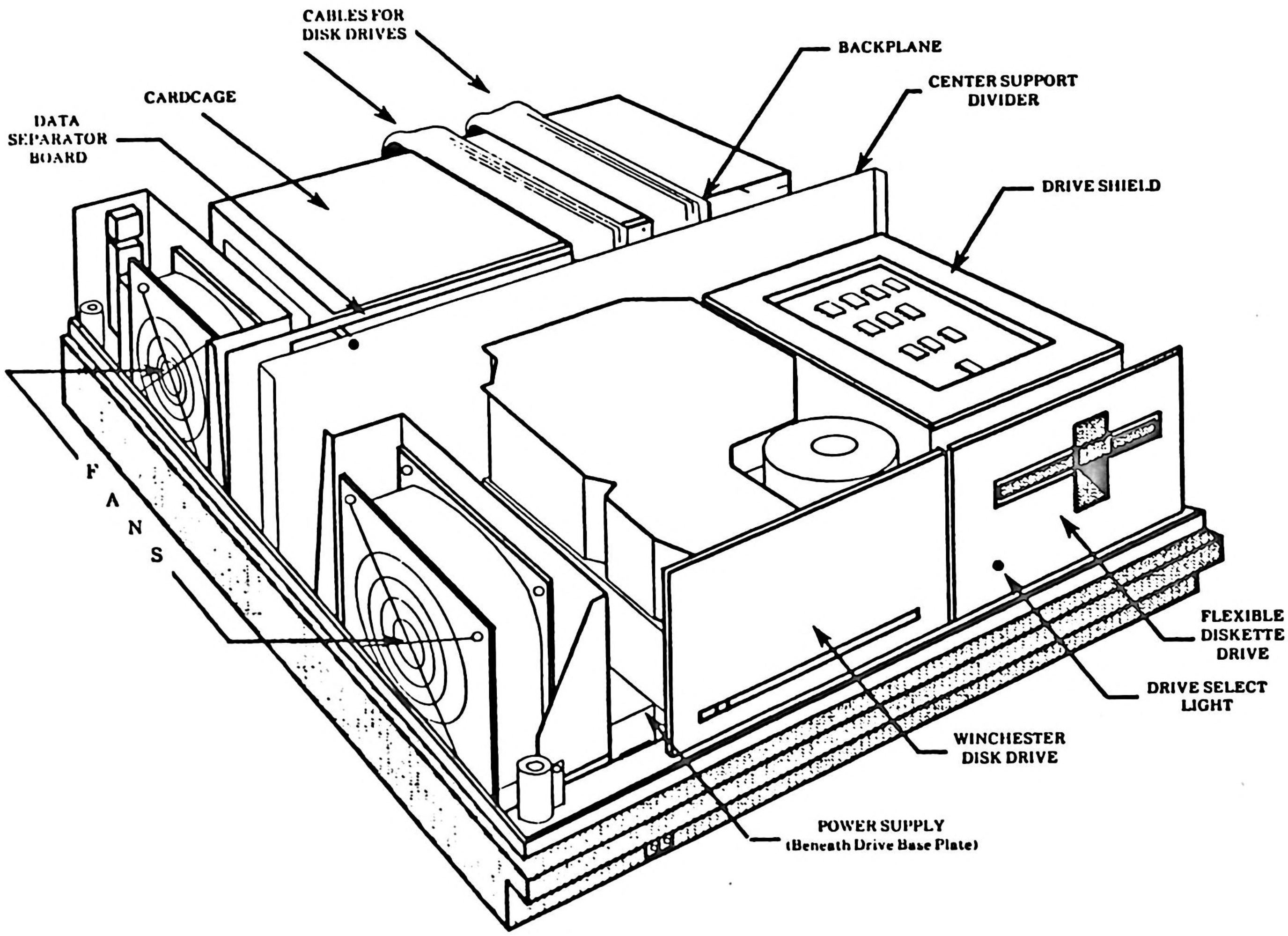


Figure 2-2. Inside View of a System 310 F-0073-1

POWER SUPPLY

The power supply, located underneath the Winchester disk drive, furnishes all the DC current for the System 310. The AC power panel routes and filters AC to the power supply. The power supply then converts AC to +5, -12, and +12 volts of DC used by all parts of the system, such as the circuit boards and disk drives. The power supply is not user-serviceable and should be replaced only by qualified service personnel.

This compact switching supply provides not only enough power to run the basic unit, but also enough power so you can change peripherals and run as many as seven MULTIBUS-compatible boards simultaneously. Chapter 3 contains more information about the AC and DC power specifications.

CARDCAGE AND BACKPLANE

The cardcage and backplane assembly houses and protects circuit boards. Boards plug into the card edge connectors on the backplane, shown mounted on the back of the cardcage in Figure 5-5. While you can modify the number of boards in the cardcage, you will not need to replace this assembly because it accommodates any configuration of the System 310 that meet the system specifications (listed in Appendix A).

Besides physically supporting the circuit boards, the backplane distributes digital signals and DC power to circuit boards and peripherals, prioritizes bus accesses, and structures the system interrupts.

To prioritize bus accesses, the backplane contains two sets of jumpers: the priority jumpers and the interrupt jumpers. The priority jumpers, shown in Figure 5-5, determine which bus master board may have access to the system bus in case of contention. Priority jumpers are preset so that the topmost slot, slot 7, has the highest priority. Chapter 5 explains how to change these jumper settings. Chapter 3 contains more information on bus priority.

To structure the system interrupts, the backplane also contains several interrupt jumpers. In preconfigured systems, the interrupt switch on the front panel is connected to the system bus with a jumper at interrupt 1 (INT1/) on the backplane. Refer to Chapter 3 for more information on how the System 310 uses interrupts and how you can change the settings.

The first two chapters explained how to recognize the hardware in the chassis. They also explained what the different hardware does and which parts you can change.

This chapter can help you integrate new hardware into a working system by describing how to use the system and board specifications to calculate compatibility. Hardware is compatible with the System 310 if it meets the three criteria listed below. Each point is expanded into a section in this chapter.

1. Physical compatibility

   You must be able to fit hardware, from the boards to the peripherals, into the system without having to rework mountings.

2. Electrical compatibility

   Hardware must adhere to the interface specifications of the System 310. For example, added boards must be not only MULTIBUS-compatible, but their total power requirements must not exceed the total power available.

3. Operational compatibility

   Hardware pieces must work together. For example, addresses cannot overlap, and system interrupts and bus priorities given to new boards must not preempt those of boards already in the system.

USING PARTS THAT FIT

You (a qualified service technician) can change disk drives enclosed by the chassis, change connectors enclosed by the back panel, or change circuit boards enclosed by the cardcage. This section describes the physical characteristics of these enclosures so you can decide if a drive or board you want to add will fit.

DISK DRIVES

The System 310 uses 5¼-inch disk drives and provides standard mounting holes for both hard and flexible drives from several manufacturers. Only 5¼-inch drives fit into the mounting holes and openings in the chassis. You can find more information about the number and type of drives available in the *System 310 Disk Configuration Guide.*

I/O CONNECTORS

The back panel accommodates up to 24 connectors of various sizes. Each connector fits into a knockout designed to fit common male or female connectors. The various sizes of connector knockouts are listed below:

Connector Type	Number Available
15-pin D sub-miniature connectors	2
25-pin D sub-miniature connectors	10
50-pin delta ribbon connectors	2
75-ohm BNC connectors	5
37-pin D sub-miniature connectors	4
36-pin delta ribbon connector	1

CIRCUIT BOARDS

The cardcage and backplane assembly governs the number, size, and type of boards that fit in the chassis. This assembly provides slots for up to seven MULTIBUS-sized boards (6.75" x 12"). Two of the seven card slots are spaced to accept cards that host MULTIMODULE boards and thus require more height clearance.

All System 310 cards communicate with each other through the backplane using an IEEE 796 standard MULTIBUS interface. In addition to this protocol, 286-based systems also support the iLBX bus interface.

NOTE

The System 310 exceeds the MULTIBUS peak-to-peak ripple tolerance specification. See Appendix A for the new numbers.

ELECTRICAL COMPATIBILITY

When choosing features, you need to know the amount of DC that the chassis supplies to the circuit cards and peripherals. Table 3-1 describes the operating parameters of the standard power supply. It lists the maximum number of amps available at each voltage level.

Table 3-1. 220-Watt Power Supply Specifications

Maximum DC Available
30.00 amps at +5 volts 4.70 amps at +12 volts 4.70 amps at -12 volts

The number of amps each slot can handle is limited by the edge connector. The *MULTIBUS Handbook,* listed in the Preface, contains all the MULTIBUS specifications.

NOTE

If you apply the power formula (P=IE) to the data in Table 3-1, you exceed 220 watts. Since you must not configure a system that draws more than 220 watts, do not design a system that uses the maximum number of amps at each voltage simultaneously.

CALCULATING DC POWER REQUIREMENTS

Use Table 3-2 to help you decide if your planned configuration is within the guidelines listed in Table 3-1. Table 3-2 shows many System 310-compatible features and the configurations that already contain that feature, followed by the maximum amount of current it draws.

Table 3-2. Maximum DC Power Consumption

Feature Name (System 310 Configuration)	+5 VDC (amps)	+12 VDC (amps)	-12 VDC (amps)
DC fans (1,-2,-3,-4,-5)	-	0.33	0.33
86/30 processor board (-1,-2,-3)	4.80	0.02	0.02
286/10 processor board with 80287 device (-4,-5)	7.10	0.05	0.05
310 firmware (-1,-2,-3,-4,-5)	0.47	-	-
101 memory manager	(Information Not Available)		
309 memory manager	2.00	-	-
304 memory board (-2)	1.40	-	-
337 math board (-2,-3)	0.45	-	-
218A controller board (-1,-2,-3,-4,-5)	0.76	-	-
5¼-inch diskette drive (-1,-2,-3,-4,-5)	0.70	1.00	-
215G Winchester controller (-2,-3,-5)	3.50	-	-
10 MB Winchester hard disk drive (-2,-3,-5)	0.94	2.40	-

Table 3-2. Maximum DC Power Consumption (Continued)

Feature Name (System 310 Configuration)	+5 VDC (amps)	+12 VDC (amps)	-12 VDC (amps)
Winchester scrambler and data separator boards (-2,-3,-5)	1.40	-	-
220 SMD drive controller	3.25	-	-
217B ¼" tape interface	1.00	-	-
216 ½" tape controller	(Information Not Available)		
012B memory board (-3)			
worst case	4.80	-	-
typical	3.46	-	-
056A memory board			
worst case	4.57	-	-
standby	0.55	-	-
012C memory board			
worst case	4.30	-	-
standby	2.50	-	-
056C memory board			
worst case	4.30	-	-
standby	2.30	-	-
012CX memory board (-4,-5)			
worst case	6.80	-	-
standby	2.50	-	-
056CX memory board			
worst case	6.60	-	-
standby	2.30	-	-
544 communication controller (no EPROM) (-4,-5)	3.30	0.35	0.20
534 communication board (without opto-isolators)	1.90	0.28	0.25
550 Ethernet* boards	9.50	0.50	-
186/51 Ethernet board	(Information Not Available)		
I^2ICE™ interface board	5.00	-	-
188/48 communications controller board	(Information Not Available)		
351 serial port	0.46	0.03	0.03
88/45 terminal controller	5.10	0.02	0.02

*Ethernet is a trademark of Xerox Corporation.

If your planned configuration uses an Intel product that is not listed in the table, you can find its DC power specifications in the manual accompanying the product.

Table 3-3 expands the part-level information in Table 3-2 to arrive at system-level information. Table 3-3 lists each preconfigured system and the total amount of power it requires, built from the data in Table 3-2.

The data is built as follows. The +5 VDC, +12 VDC, and -12 VDC columns in Table 3-3 are the sum of the numbers in the corresponding columns in Table 3-2 for each system configuration. The "Watts" column contains the total power consumed. This column is calculated by applying the power formula (P=IE; where P is watts, I is amps, and E is volts).

Table 3-3. DC Power Consumed by Each System

System	+5 VDC (amps)	+12 VDC (amps)	-12 VDC (amps)	Watts (P=IE)
310-1	6.73	1.35	0.35	54.05
310-2	15.83	3.75	0.35	133.35
310-3	17.04	3.75	0.35	134.40
310-4	14.83	1.35	0.35	94.55
310-5	21.23	3.75	0.35	155.35

Tables 3-2 and 3-3 can serve as models for calculating requirements for modified systems. Once you arrive at the amount of power your modified system will consume, you can use Table 3-1 to verify that this figure does not exceed the total amount of watts allowed by the power supply (220 watts).

Using Tables 3-1, 3-2, and 3-3, you can calculate this figure in two steps:

1. Subtract the total number of amps in each voltage category shown in Table 3-3, from the totals shown in Table 3-1. For example, subtract 6.73 amps (shown in the +5 VDC column of Table 3-3) from 30 amps (shown as the maximun DC current available in Table 3-1). This leaves 23.27 amps of +5 volts remaining. Do the same for -12 and +12 volt categories.

2. When you have calculated the amount of DC current your modification will consume, apply the P=IE formula. Continuing the example, you would multiply 6.73 amps by 5 volts to get 33.65 watts. Calculate the number of watts consumed for the -12 and +12 voltages, then add them together. In the example, this total is 54.05 as shown in the "Watts" column of Table 3-3. If this number exceeds 220 watts, you must redesign your system.

OPERATING COMPATIBILITY

While calculating mechanical and electrical compatibility is straightforward, making sure modifications do not conflict with the operation of the system is more subtle. This section covers three areas of compatibility you must consider when designing a system: port and device addressing, system interrupts, and bus contention.

ADDRESSING

Your processor board regulates the amount of memory you can address. For example, an 86-based system uses 20 lines to directly address one megabyte of memory. Other than that, the system hardware imposes few restrictions on memory placement. They are:

- The addresses of features (such as disk controllers) may not overlap.
- RAM must occupy contiguous address space, starting at 00000H.
- System firmware must start at a specific address depending on the type of processor board used.
- The number of ports depends on the type of processor board used.

The System 310 processor configuration guides and memory configuration guides, listed in the Preface, contain more information on specific addressing requirements.

SYSTEM INTERRUPTS

The 86-based systems permit eight system interrupts while the 286-based systems permit 16 system interrupts. In both cases, the System 310 uses seven of these interrupts for disk controllers, front panel switches, and similar system functions. The remainder are available for you to define by setting jumpers on the backplane.

Since no interrupt handling software drivers are supplied with the System 310, you will first need to write them before using the remaining interrupts. Consult the System 310 processor configuration guides for interrupt assignments. Chapter 5 in this manual explains how to change the interrupt jumpers on the backplane.

BUS CONTENTION

When designing a system, you must avoid having two bus master boards acquire the bus at the same time. The System 310 avoids this contention by assigning a priority number to each card slot. The number describes the order in which conflicting bus requests are resolved.

All preconfigured systems prioritize the slots in the cardcage from the bottom up; e.g., slot 1 is the bottom slot and has the lowest priority. Although slots are not physically numbered, their order is shown in Figure 5-5.

You can change the bus priority two ways: by changing the order of the boards or by changing jumpers on the backplane. Since it is easier to reach the boards than the jumpers, changing the order of the boards is probably more convenient.

Boards, in all preconfigured versions of the System 310, are set up for parallel priority resolution rather than serial priority resolution. The System 310 backplane contains this resolution logic. Since all boards in a MULTIBUS-based system must resolve priority in the same way, be sure to remove the appropriate jumpers on new bus master boards. The hardware reference manual for each Intel bus master product explains how to make this simple change.

Board Placement Guidelines

As mentioned previously, the placement of bus master boards in the cardcage determines the priority of that board. In preconfigured systems, the 215G Winchester disk controller board (if present) has the highest priority and the processor board the next highest.

The 215G disk controller occupies the highest priority slot (slot 7 at the top of the cardcage) because this board needs the fastest access time. Lowering its priority would slow the entire system down by forcing the controller board to wait for a higher priority board to relinquish the bus. Data acquisition can be further delayed by disk latency.

In preconfigured systems, the processor board has the next highest priority. (In preconfigured systems without a 215G board, the processor has the highest priority.) It is located in the bottom slot, slot 1. Although slot 1 has the lowest priority, the processor has the second highest priority in preconfigured systems because there are no other bus master boards between it and the controller in slot 7.

Regardless of the priority of the processor board, it must always reside in slot 1. This is because the processor boards use the P2 connector (the smaller of the two gold-fingered card edges) for upper address lines and the interrupt from the front panel switch. Slot 1 is the only slot in the cardcage that provides a matching P2 edge connector.

Once you have established the order of the bus masters in the cardcage, synchronize them with the BCLK signal. All MULTIBUS-based systems require a signal called BCLK (bus clock) to synchronize the operation of the bus. Therefore, one and only one of your bus masters should generate this signal. You can find more information on this topic and on other MULTIBUS hardware configuration techniques in the *Guide to Configuring MULTIBUS-Based Systems* and the *MULTIBUS Handbook*.

If you look back at the block diagram of a typical System 310 (Figure 1-2) you will see the system broken down into functional blocks. This chapter provides the list of circuit boards that you can substitute for each block when constructing a system. The functional blocks covered as sections in this chapter are listed below:

- Processor boards
- Processor-specific expansion boards (shown as the Memory block on the processor board and the boards on the iSBX bus)
- Disk controllers
- Tape controllers
- Memory boards
- Communication controllers

While the last chapter presented some general guidelines for integrating new hardware into a preconfigured System 310, this chapter presents board-specific guidelines. For each board listed, sections in this chapter specify whether or not you will have to do anything special to the board or your system to make them work together. If the board needs no modificaton, that is noted. On the other hand, if you must make a modification, this chapter points out whether it is a jumper change or a component change, and tells you where you can find more specific information.

COMPATIBLE PROCESSOR BOARDS

The processor board characterizes the System 310 in two ways: by the software it executes and by the performance of the hardware. The processor governs the type of software that you can run. For example, a single-user, 86-based system running the iRMX™ 86 operating system acts quite differently from a multiple-user, 286-based system running the XENIX* operating system. The processor board also governs the performance of the hardware, including its operating speed and the number and kind of I/O ports available.

You can buy or build a System 310 around either the 86/30 or the 286/10 processor board. The primary difference between these boards lies in the CPUs they use. Other hardware differences are listed in Table 4-1.

*XENIX is a trademark of Microsoft Corporation.

Table 4-1. Compatible Processor Boards

Processor Board	List of Major Features	Systems Where Used
iSBC 86/30	8086 CPU 1 RS-232 serial port 1 Centronics-type parallel port 128K bytes on-board RAM 2 iSBX connectors	-1,-2,-3
iSBC 286/10	80286 CPU 2 RS-232 serial ports 1 Centronics-type parallel port iLBX bus interface 2 iSBX connectors	-4,-5

Notes:

- Only certain MULTIMODULE boards are compatible with these processor boards. (See Table 4-2 for the list.)

- Using expansion boards of any kind requires jumper changes on the processor board. Refer to the processor configuration guide that covers the processor you are using for more information. These manuals are listed in the Preface.

- Whenever you change the location of the 218A diskette drive controller, you must also change firmware on the processor board (contained in four PROMs). Refer to the *System 310 Disk Configuration Guide* for complete details. Also, the notes following Table 4-3 contain similar information on firmware requirements. New PROMs can be obtained through your local FAE.

ADDING EXPANSION BOARDS ON THE PROCESSOR BOARDS

Expansion boards, by attaching directly to a host board, add functions without using up card slots. There are three kinds of expansion boards that attach to the processor board: MULTIMODULE boards, iSBX system expansion boards, and iSXM™ system expansion boards. Table 4-2 lists the expansion boards designed for the processor boards in Table 4-1.

Table 4-2. Compatible Expansion Boards

Expansion Board	Major Features	Compatible Processor Board
iSBC 337	Floating-point math (a MULTIMODULE board)	86/30
iSBC 304	128K bytes RAM (a MULTIMODULE board)	86/30
iSBC 309	Memory management Floating-point math (a MULTIMODULE board)	86/30
iSBC 341	RAM/EPROM expansion (a MULTIMODULE board)	286/10
iSXM 101	Memory management Floating-point math	86/30

Notes:

- The 309 and 101 boards each provide a socket for the 8087 math coprocessor. You must supply the chip.
- The 101 memory management board is a kit version of the 309 board.
- Floating-point math is a standard feature on the 286/10 processor board.
- Adding the 304 RAM board only requires one address jumper change on the 86/30 processor board and a new decode PROM. New PROMs are supplied with the 304 RAM kit.
- When using the 8087 math coprocessor, used on the 309 and 101 memory management boards and the 337 math board, verify that the 86/30 board is jumpered for 5 MHz rather than 8 MHz. No jumper changes are needed on the memory management or math boards. Refer to the System 310 processor configuration guides listed in the preface for specific jumpering information.

COMPATIBLE DISK CONTROLLERS

The System 310 chassis houses up to two 5¼-inch disk drives. The controllers for these drives reside in the chassis cardcage. Diskette drives use a single iSBX-type controller board while Winchester hard disk drives require a drive controller and two additional boards. Table 4-3 lists all the supported drive controllers and the additional boards they may require.

Table 4-3. Compatible Disk Controllers

Controller Board	Description	Systems Where Used
iSBX 218A	Diskette drive controller	-1,-2,-3,-4,-5
iSBC 215G	Winchester drive controller	-2,-3,-5
iSBC 220	SMD drive controller	None*

*Intel supports this board in 86-based configurations, but does not supply it as part of the preconfigured System 310.

Notes:

- The 215G board needs the 213A data separator and the Winchester scrambler board when controlling $5\frac{1}{4}$-inch drives. (The 213A board is not required for 8-inch drives.)
- Changing interrupt assignments to accommodate the controller board requires jumper changes to the processor board. Refer to the *System 310 Disk Configuration Guide* for jumper changes.
- There are two sets of firmware on the processor board. Which set you have depends on where the 218A controller board is located. The *System 310 Disk Configuration Guide* explains when and how to change firmware.
- The 218A controller board needs no special configuration when mounted on a 215G controller board. Installing the 218A controller on the 86/30 processor, however, requires different firmware and several jumper changes to both boards. You can mount the 218A controller on any board with an iSBX connector.
- Software drivers in the iRMX operating systems disable interrupts when the 218A controller board is mounted on the processor board. Because this prevents Direct Memory Accesses (DMA), real-time system performance is degraded. The 218A controller yields the most efficient performance when mounted on the 215G controller board, where you may use interrupts.
- XENIX does not support configurations where the 218A is mounted on the processor board.

COMPATIBLE TAPE CONTROLLERS

While not part of a preconfigured system, tape controller boards allow the System 310 to support two kinds of external tape drives, listed in Table 4-4.

Table 4-4. Compatible Tape Controllers

Controller Board	Description
iSBX 217A	¼-inch tape drive controller
iSBX 216	½-inch tape drive controller

Notes:

- Tape drives are supported by firmware found on the 215G Winchester hard disk controller board.
- Tape drives are not supported by iRMX 86 and iRMX 286R Operating Systems. You must write your own software drivers.
- Versions of these controllers support start/stop and streamer tape drives.

COMPATIBLE MEMORY BOARDS

The System 310 uses three types of memory: RAM boards, RAM boards with Error Correction Codes (ECC), and RAM boards with both ECC and Local Bus Expansion (iLBX).

Table 4-5 lists the compatible memory board products containing these features. Any of the listed boards, with modification, will work in any System 310, although some work better with certain processors. (See the notes following the table.)

Table 4-5. Compatible Memory Boards

Memory Boards	List of Major Features	Systems Where Used
iSBC 012B	512K bytes RAM	-3
iSBC 056A	256K bytes RAM	None*
iSBC 012C	512K bytes ECC RAM	None
iSBC 056C	256K bytes ECC RAM	None
iSBC 012CX	512K bytes ECC RAM iLBX bus control	-4,-5
iSBC 056CX	256K bytes ECC RAM iLBX bus control	None
iSBC 304	128K bytes RAM	-2

*Intel supports this board but does not supply it as part of the preconfigured System 310.

Notes:

- All memory boards can be used in 86- or 286-based systems except the 304 board, which only works with the 86/30 processor board. (See Table 4-2.)
- Usually, you will need to change the jumpers that select addresses on the memory and processor boards before using the memory board in a System 310.
- Memory boards provide parity and battery back-up circuits but the System 310 does not supply supporting software routines.
- The software needed for the ECC circuitry is not supplied.
- Only 286-based systems support the iLBX bus. Therefore, CX memory boards (e.g., 012CX) can be used to their fullest advantage only in 286-based systems.

COMPATIBLE COMMUNICATION CONTROLLERS

Table 4-6 lists seven I/O communication controllers. These boards provide a range of features from programmable serial channels to Ethernet controllers. The notes that follow the table point out which display controllers are also available as kits.

Table 4-6. Communication Controllers

Controller Board	List of Major Features	Number of Slots Needed
iSBX 351	1 programmable serial port	None*
iSBX 534	Dumb terminal controller 4 programmable serial ports 2 programmable timers	1
iSBX 544	Smart terminal controller 4 programmable serial ports 3 programmable timers 1 programmable parallel port	1

Table 4-6. Communication Controllers (Continued)

Controller Board	List of Major Features	Numberof Slots Needed
iSBC 88/45	Data communication processor 3 programmable serial ports or 2 serial and 1 parallel port 6 programmable timers	1
iSBC 188/48	Advanced communications controller 8 programmable serial ports 4 programmable timers	1
iSBC 550	Ethernet controller	2
iSBC 186/51	Ethernet controller	1

* This board attaches to any board containing an iSBX connector and thus shares the same slot as its host board.

Notes:

- The boards in this section work without modification in either 86- or 286-based System 310's.
- The 351 MULTIMODULE board always requires jumper changes.
- The 544, 188/48, and 88/45 boards each require one interrupt. In the System 310, this is usually interrupt 3 (set on the processor board). Interrupt 3 is the only available interrupt in preconfigured 86-based systems.
- The 550 is a two-board set. It draws more current than most boards (about 8 amps at +5 VDC). When purchased as a kit, no special configuration is necessary.
- The 186/51 is a single board. It draws less power than the 550 controller set. When purchased as a kit, no special configuration is necessary.
- The 188/48 board is similar to the 88/45 but it uses the faster 80188 microprocessor and provides additional serial ports. No jumper changes are necessary.
- Ethernet controllers should not be used in systems running XENIX software. XENIX does not support Ethernet.

This chapter describes how to remove and install many of the components in the System 310 chassis. The intent is to show you how to reconfigure, not service, your system. Service information is contained in the *System 310 Hardware Maintenance Manual.*

This chapter provides step-by-step instructions for installing and removing the following parts:

- Fuse and voltage selector
- Back panel, connectors, and jumpers
- Top cover
- Backplane and cardcage priority and interrupt jumpers

There are two ways to open the chassis to alter the hardware: (1) by opening the back panel; and (2) by removing the top cover. Only boards, fuses, and connectors can be installed by removing the back panel. You must remove the top cover to make all other hardware changes.

WARNING

> Operators cannot service any parts that can be reached by removing the chassis back panel except the cardcage and the boards within it. Only qualified service personnel should attempt to do so.

CHANGING HARDWARE WITHOUT REMOVING THE COVER

The back panel and the AC panel make up the back of the System 310 chassis. Components that you are most likely to use, such as the on/off switch, can be reached from the back. You can install the AC power plug, change the fuse, or select a different AC line voltage on the AC power panel; you can change cables and connectors on the back panel; and, by removing the back panel, you can change the boards in the cardcage.

CHANGING THE FUSE AND VOLTAGE SELECTOR

You must replace the fuse when the fuse is blown or when you change line voltages. For 100 or 120 VAC lines, use the 6-amp, 250-volt fuse already installed in your system. For 220 or 240 VAC lines, you must exchange the 6-amp fuse for a 3-amp, 250-volt fuse, and turn the voltage selector board.

Equipment You Will Need

A pair of needle-nosed pliers.

Steps

The AC line filter, where you plug in the power cord, also houses the fuse and voltage selector board. Figure 5-1 shows the location of these parts. Since you must remove the fuse to change the voltage selection, the six steps in this section explain how to perform both tasks.

Specifically, steps 1, 2, 3, and 6 refer to changing the fuse. Steps 4 and 5, which explain how to choose a different voltage setting, are inserted into the fuse-changing instructions at the appropriate point. If you want to change the fuse and the voltage selection, follow all six steps in order. The entire process takes about 10 minutes.

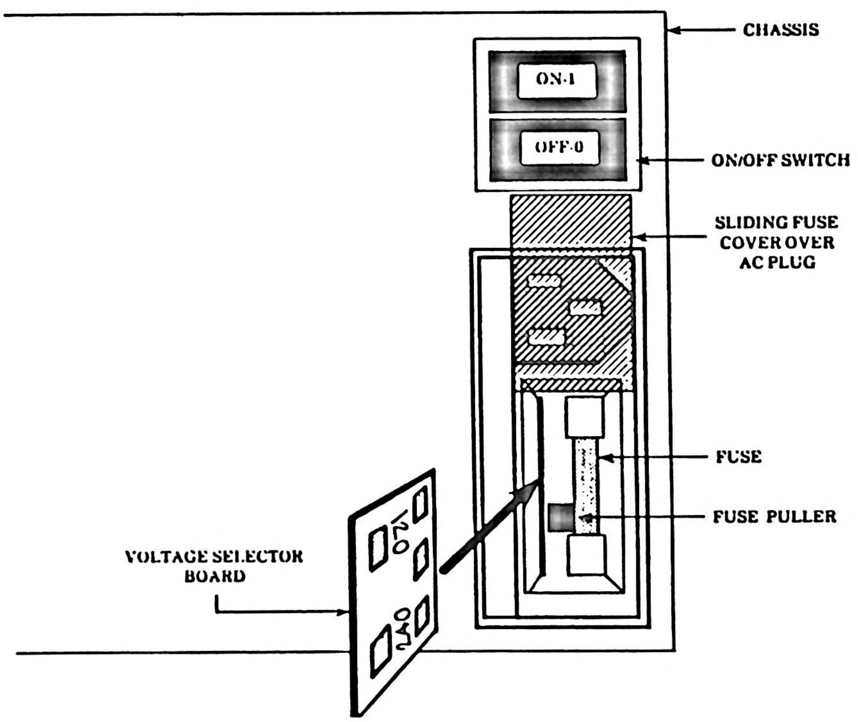


Figure 5-1. Changing the Fuse and Voltage Selector F-0125

1. Unplug the AC power cord from the back of the system. Turn the chassis so the back faces you.

2. Slide the fuse cover up to expose the fuse and voltage selector board, shown in Figure 5-1. The AC plug must be removed before this panel can slide.

3. Remove the fuse by pulling up on the small black lever labeled "FUSE PULL." This ejects the bottom of the fuse from the fuse holder so you can catch it with your fingers and pull it all the way out. Leave the fuse-pull lever up to keep the sliding cover out of your way.

Inspect the old fuse to see if the filament is broken or burned. If an ohmmeter is available, use it to check for continuity. If there is no evidence of damage, and replacing the fuse does not correct your problem, call the service number listed in the front of this manual for assistance.

At this stage, you can also change the voltage selection by continuing with steps 4 and 5. Otherwise, skip to step 6.

4. Raise the fuse-pull lever, if it is not up already, so it is out of the way of the voltage selector board. Using the needle-nosed pliers, grab the board in the middle where there are no exposed contacts. Wiggle the board up and down until it loosens, and pull it straight out toward you.

CAUTION

> Some voltage selector boards are hard to remove. Be careful not to use excessive force while wiggling them loose because the pliers can damage the board.

5. Select a new voltage setting and install the board. Four numbers are printed on this board: 120 and 240 on one side, and 100 and 220 on the other side. Replace the board so that the voltage number you choose faces you when you install the board. Figure 5-1 shows how to orient the board to select 120 volts (the default selection). Push the board firmly back into place until the fuse-pull lever is free to drop down.

6. Pull the fuse-pull lever down if it has not already dropped down and replace the fuse. It does not matter which way you insert the fuse. Remember to install the 6-amp fuse for 100 or 120 VAC systems and the 3-amp fuse for 220 to 240 VAC systems. Fuse ratings are scribed on the metal part of the fuse. You can now plug in the power cord and turn the system on.

REMOVING AND INSTALLING THE BACK PANEL

The three major steps in this section describe how to remove the back panel, disconnect and connect the cables, and install the back panel. Each set of instructions takes about five minutes to perform.

The back panel covers the cardcage, so whenever you remove or install circuit cards, cables, or connectors, you will need to follow these instructions.

WARNING

> To guard against a risk of fire or electrical shock, *always* disconnect the power cord before removing the chassis back panel.

Equipment You Will Need

A Phillips screwdriver for #6 screws.

Removing the Back Panel

1. Turn the chassis so that the back is facing you.

2. Remove the AC power cord from the back of the chassis.

3. Remove the four screws that secure the back panel, two #6 machine screws and two #8 sheet-metal screws. Save these screws and remember where they came from so you can reinsert them later.

4. Tilt the top of the back panel toward you and lift it out of the track at the bottom of the chassis. Disconnect the cables from the boards and lay the back panel on top of the chassis cover. Remember where these cables came from, or mark them, so you can correctly replace them later.

5. If you are changing any cards in the cardcage, remove the card retainers first. There are two #6 screws in each retainer.

Connecting the Cables

After all boards are returned to the cardcage and the card retainers are replaced, connect the loose cables before replacing the back panel.

Since it is not possible to know exactly what cables you have installed in your system, this section explains cable marking conventions and describes how to install some of the commonly used drive cables.

When connecting the serial and parallel port cables to the processor board, refer to the System 310 processor configuration guide, listed in the Preface, that covers the particular processor board you are using.

Cable Marking Conventions. To help you correctly match cables with connectors, they are marked with a part number and reference designation. The reference designation is either a P number (e.g., P1) or a J number (e.g., J1). These numbers, along with the piece part number, appear on the connector where space permits. A complete wiring diagram appears in the *System 310 Hardware Maintenance Manual.*

Connect cables by matching a P number to a J number. Since P and J numbers are not unique thoughout the system, be sure you either remember where each cable came from or refer to Figures 5-2 and 5-3. When plugged in correctly, the P and J numbers appear on the same side as the components on the board the cable connects to. The exceptions are noted in these figures.

Connecting the Diskette Drive Cables. Systems that have diskette drives have one cable that connects the drives to the 218A controller. Install the connector labeled P1 (part number 172967) to the only connector on the 218A controller board, J1. You can easily recognize this cable because it has a 34-conductor ribbon cable attached to a 50-pin connector.

Figure 5-2 shows the connections for several commonly used drive cables. The number or order of the cables in your system may be different depending on your configuration.

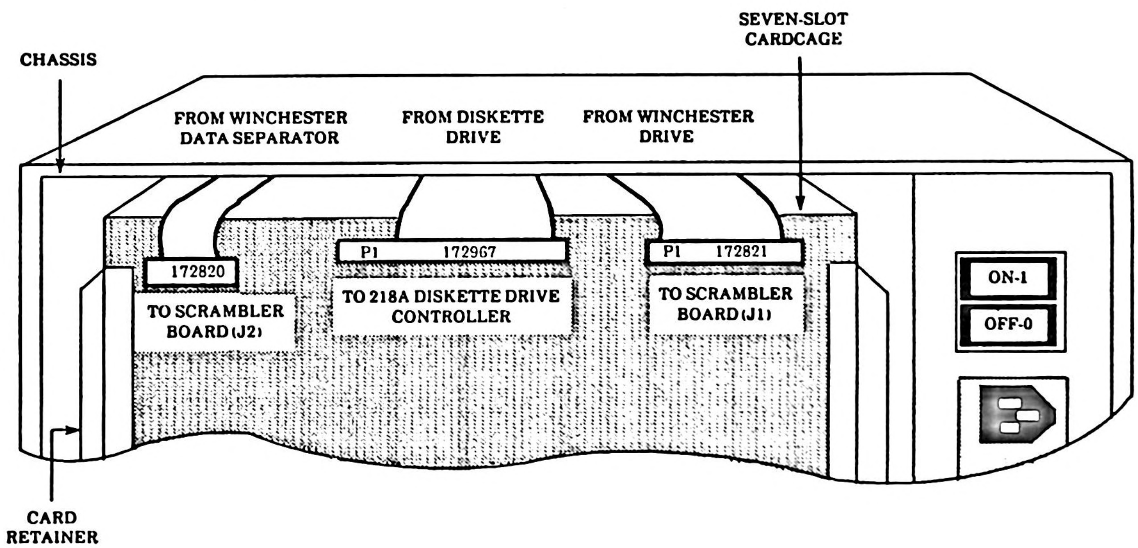


Figure 5-2. Drive Cables Viewed from the Cardcage F-0123

Connecting the Winchester Disk Drive Cables. There are up to four Winchester drive cables the can be disconnected from inside the cardcage. They all meet at the Winchester scrambler board. Specifically, these cables join the drive to its controller board and the required data separator and scrambler boards. The scrambler board translates the order of the signals so they are compatible with the drive controller's cable pinout. All the Winchester drive cables from the controller board must pass through the scrambler and then to their respective boards.

Since it is difficult to see where each cable comes from when the system is covered, you can use Figure 5-3 as a guide. It shows the four cables meeting at the Winchester scrambler board mounted on the inside of the back panel. The inset shows the orientation of the larger cable drawing. It shows the location of the scrambler board and the 215G controller board with the back panel ajar. The larger drawing shows the connections at the scrambler board as though you were looking down on the back panel. Refer to this drawing, and the four steps that follow, to connect the Winchester drive cables.

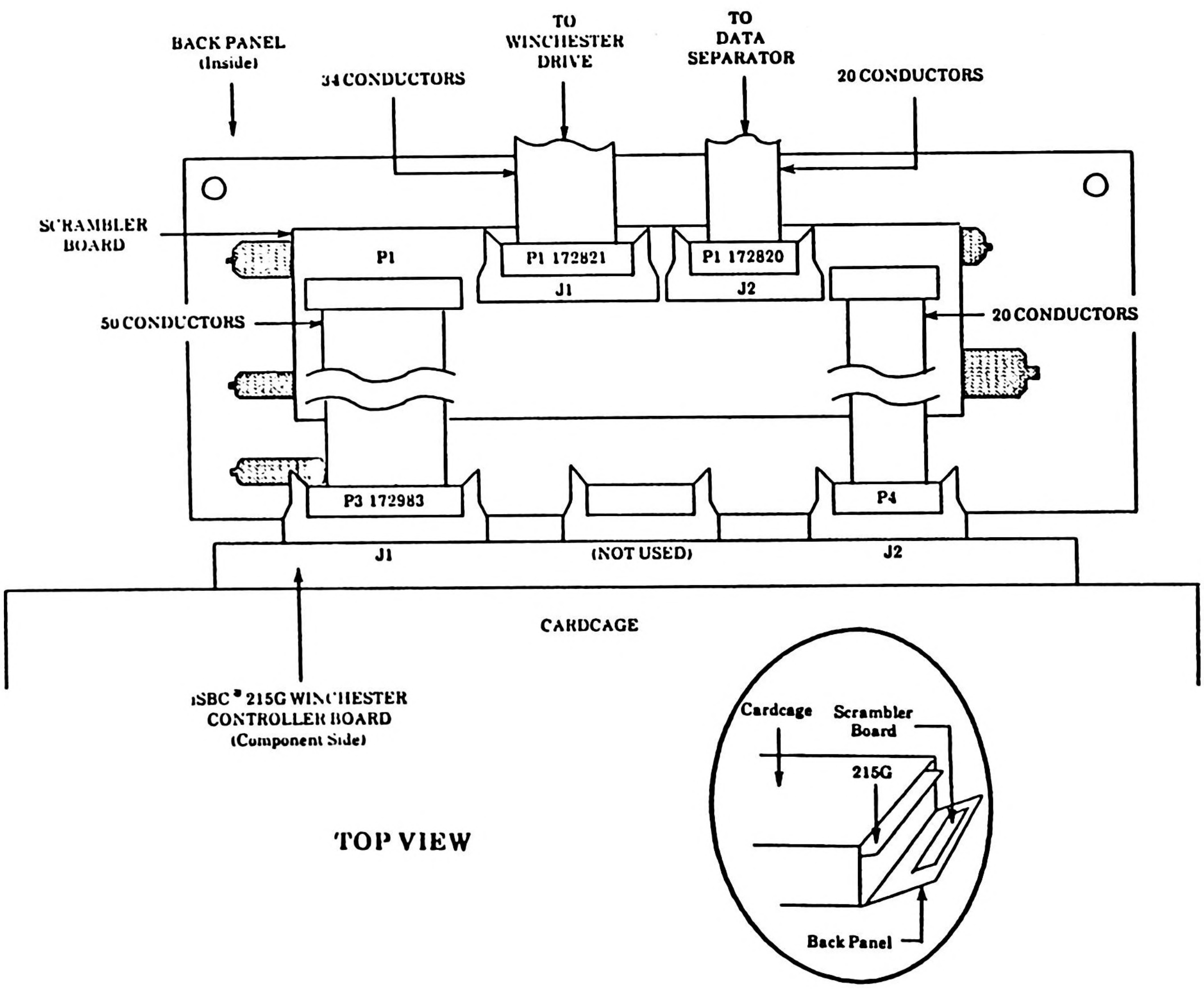


Figure 5-3. Connecting the Winchester Disk Drive Cables

1. Connect the 34-conductor cable coming from the Winchester drive to J1 of the Winchester scrambler board.

2. Connect the 20-conductor cable coming from the data separator board to J2 of the Winchester scrambler board.

3. Connect the 50-conductor cable coming from P1 on the Winchester scrambler board to J1 on the 215G Winchester controller board.

4. Connect the 20-conductor cable coming from P2 on the Winchester scrambler board to J2 on the 215G Winchester controller board.

Installing the Back Panel

The eight steps in this section describe how to replace the back panel on the chassis. Essentially, it is the reverse of the removal process presented earlier in this chapter.

1. Install the card retainers using the four #6 screws you saved.

2. Line up the back panel with the chassis so that the cables face in toward the cardcage. Reconnect any loose cables.

3. Insert the bottom of the back panel into the track at the bottom of the chassis.

4. Carefully fit the excess cable into the space between the processor board and the back panel.

5. Tilt the back panel toward the cardcage until it fits flat against the chassis.

6. Align the screw holes in the back panel with the screw holes in the chassis making sure not to pinch any cables.

7. Replace the four screws you saved, two #6 machine screws and two #8 sheet-metal screws.

8. Install the AC plug. Turning on the System 310 automatically invokes the System Confidence Tests (SCTs). If the system passes all the tests, you have not created any hardware problems by installing or removing parts.

CHANGING HARDWARE INSIDE THE CHASSIS

The top cover must be removed to service parts in the chassis, remove or install the disk drives, or change the priority jumpers on the backplane of the cardcage. Remember, only qualified service technicians should remove this cover.

REMOVING AND INSTALLING THE TOP COVER

There are seven steps in this section. The first five steps explain how to remove the cover. The last two steps explain how to replace it again.

These instructions are specifically for a table-mounted System 310 chassis. If you have rack-mount or floor-stand attachments installed, remove them and place the chassis on a table before proceeding.

Equipment You Will Need

A Phillips screwdriver for #6 screws.

Removing the Top Cover

1. Disconnect the AC power cord and any peripherals attached to the back panel.

2. With one of the narrow sides facing you, carefully upend the chassis until it balances on its side.

3. While holding the chassis in this upright position with one hand, loosen and remove the four #6 screws shown in Figure 5-4. Save these screws.

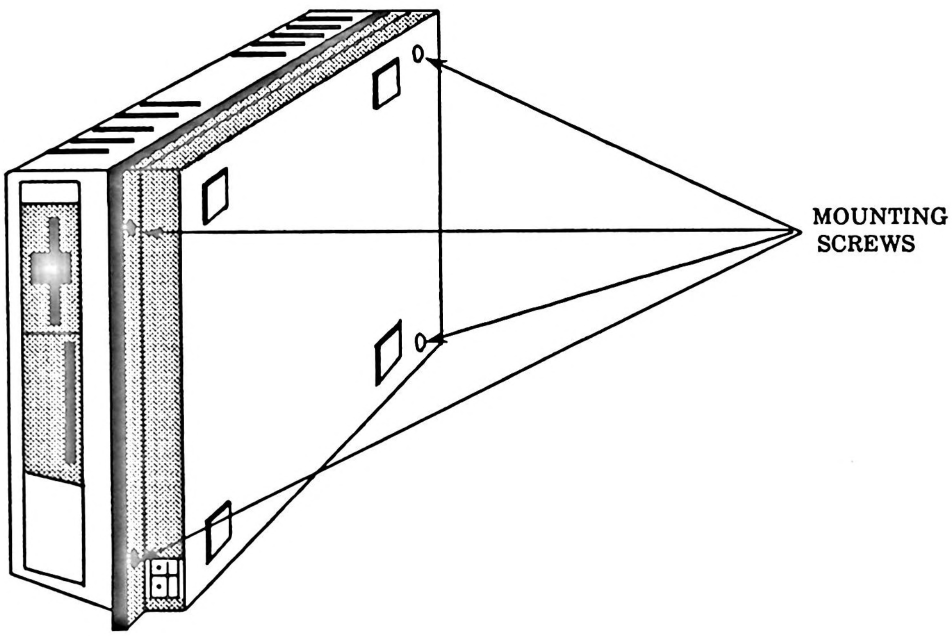


Figure 5-4. Mounting Screws for the Top Cover F-0120

4. Carefully lower the chassis while holding the top cover in place. The chassis weighs about 40 pounds so be careful you do not lose control and drop it.

5. Lift the top cover straight up and off its base to expose the inside of the chassis. Set the cover aside, with its mounting screws, until you are ready to install it again.

Installing the Top Cover

1. After connecting all the cables and making sure all internal components are secured to their mountings, lower the chassis cover onto its base.

2. While holding the cover on, roll the chassis over on one of its narrow sides as you did in step 2 of the last section. Replace the four mounting screws into the bottom of the chassis and lower the chassis back down.

CHANGING THE JUMPERS ON THE BACKPLANE

The backplane contains the jumper areas for setting system interrupts and bus slot priorities. If you need to change them, follow the next seven instructions. The first four instructions explain how to change the interrupt jumpers. The last three instructions explain how to change the priority jumpers.

Interrupt Jumpers

1. Remove the back panel from the chassis by following the instructions found earlier in this chapter.

2. Remove as many circuit boards as necessary to reach the jumpers found above the card edge connector for slot 7 (the top slot). If you disconnect any cables to do this, remember or mark where they go so you can install them correctly afterward. If you forget, refer to the section found earlier in this chapter on connecting cables.

3. Find the interrupt jumpers by looking into the cardcage. These jumpers appear just above the top card edge connector and are labeled INT0/ through INT7/. If you have a factory-standard system, there is a jumper installed across the posts labeled INT1/ as shown in Figure 5-5.

4. To change these jumpers, reach into the cardcage with your fingers and move the jumper to another location.

CAUTION

> Do not use pliers to remove the jumpers because they can damage the soft plastic jumper connector. Use a small hooked tool or your fingers.

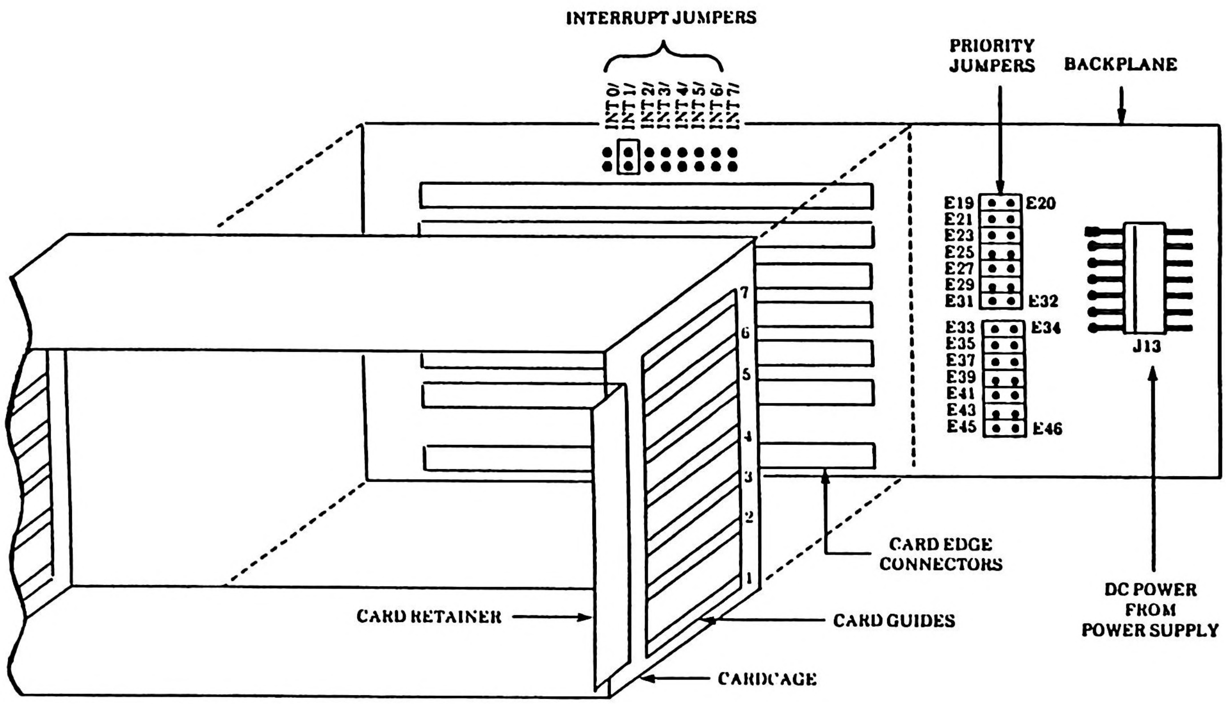


Figure 5-5. Jumper Locations on the Backplane F-0152

Priority Jumpers

To change the priority of the card slots, you must first remove the top cover. Follow the instructions that appear earlier in this chapter for removing the top cover, then continue.

1. Find the priority jumpers to the right of the cardcage on the backplane. The location of these jumpers is shown in Figure 5-5. Table 5-1 describes how the factory sets the jumpers.

2. Pull the black jumper blocks off their posts and rewire the connections. Calculate which connections to remove using Table 5-1 and the following instructions.

Table 5-1. Priority of the Card Slots

Input Connection	Output Connection	Slot Priority
(BREQ1) E45-E46	(BPRN1) E31-E32	#1 (lowest)
(BREQ2) E43-E44	(BPRN2) E29-E30	#2
(BREQ3) E41-E42	(BPRN3) E27-E28	#3
(BREQ4) E39-E40	(BPRN4) E25-E26	#4
(BREQ5) E37-E38	(BPRN5) E23-E24	#5
(BREQ6) E35-E36	(BPRN6) E21-E22	#6
(BREQ7) E33-E34	(BPRN7) E19-E20	#7 (highest)

This table shows two categories of signals: the input signals (Bus Request--BREQ) and the output signals (Bus Priority In--BPRN). The combination of an input pair with an output pair determines the priority of the slot. Each row in this table represents the preconfigured connections for one slot. In preconfigured systems, the slot numbers and the priority numbers are the same.

Each signal name (e.g., BREQ1) has a priority number following it. When properly connected, both the input and output priority numbers match. For example, the table shows BREQ1 connections combined with BPRN1 connections to give slot 1 the lowest priority; the 1's match.

Using Table 5-1, you can change slot priority in two steps:

a. Find the rows in the table that represent the priority of the slot(s) you want to change and disconnect all the jumpers listed.

b. Reconnect an input jumper and an output jumper for each slot. Even-numbered jumpers always connect to odd-numbered jumpers.

For example, suppose you want to change slot 1 from the lowest to the highest priority. First, find the two rows for slot 1 and slot 7 and remove all four jumpers (E45-E46, E31-E32, E33-E34, and E19-E20).

To swap the priority of these two slots, reconnect an input jumper pair and an output jumper pair. Specifically, for the input pair, connect the odd-numbered jumper, E45, to the even-numbered jumper, E34. For the output pair, connect the odd-numbered jumper, E31, to the even-numbered jumper, E20. This gives slot 1 the highest priority. Figure 5-6 shows these connections.

To finish the swap and change slot 7's priority to 1, connect the remaining input and output pairs. Connect E46 to E33 and E32 to E19 to change slot 7 from the highest priority to the lowest.

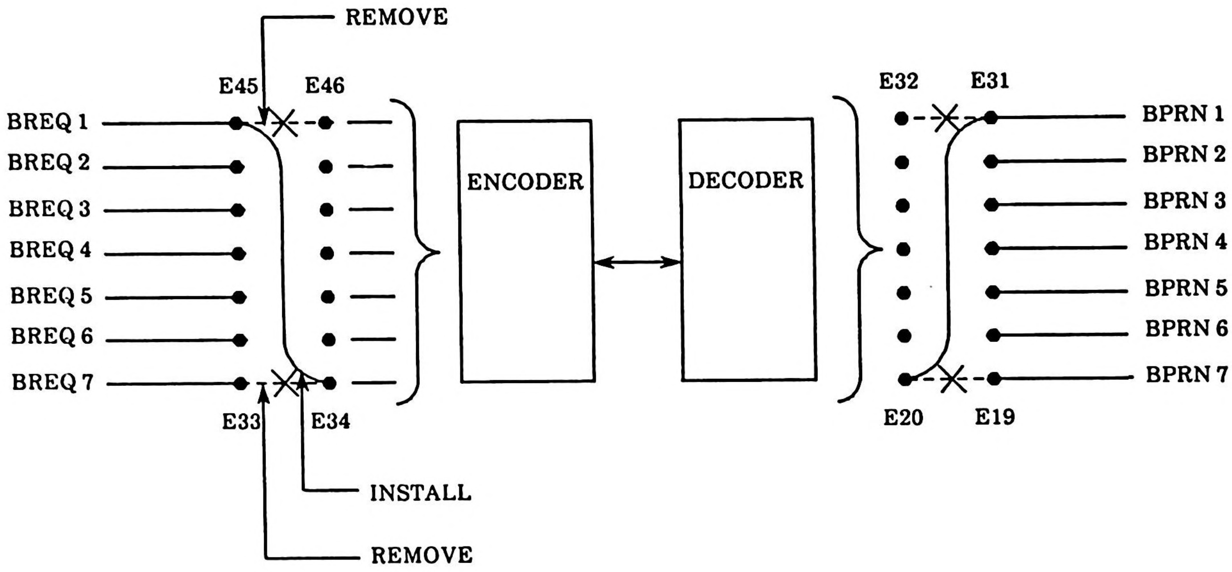


Figure 5-6. Choosing New Card Slot Priorities F-0069

3. When you are finished, replace the top cover (if removed) and back panel according the instructions found earlier in this chapter.

MECHANICAL PACKAGING

Height	6.5 inches
Width	17 inches
Depth	20 inches
Weight	40 pounds

ELECTRICAL CHARACTERISTICS

DC Specifications

+5 VDC ± 5%	Maximum current 30.0 amps
+12 VDC ± 5%	Maximum current 4.7 amps
-12 VDC ± 5%	Maximum current 4.7 amps

Note: Maximum power for all power supply outputs combined cannot exceed 220 watts of DC power.

AC Specifications

198 to 264 VAC

47 to 63 Hz

Note: Maximum power consumption is 523 watts.

Fuse ratings

115-volt range

6-amp, normal-blo fuse

230-volt range

3-amp, normal-blo fuse

INTERFACE

Bus interface

IEEE 796 MULTIBUS interface

Ripple voltage exception

100 Mv peak-to-peak on +5 volt line

120 Mv peak-to-peak on +12 and -12 volt lines

Serial interface

RS-232C

Parallel interface

Centronics-compatible

ALTITUDE

Operating

Sea level to 8000 feet

Nonoperating

Sea level to 40,000 feet

TEMPERATURE

Operating

10° to 35° C (using flexible diskettes)

Nonoperating

10° to 51° C (using flexible diskettes)

-34° to 60° C (not using flexible diskettes)

HUMIDITY

Operating

26° C maximum, wet bulb
20 to 80% noncondensing

ELECTROSTATIC DISCHARGE

Withstands 8 kilovolts (when attached cables and devices also meet this requirement)

SHOCK

Systems containing flexible diskette drives:
- Operating
  - 1 g for 10 to 20 ms
- Nonoperating
  - 15.0 g's for 10 to 20 ms

Systems containing Winchester hard disk drives:
- Operating
  - 5 g's
- Nonoperating
  - 20 g's

VIBRATION

Systems containing flexible diskette drives:
- Operating
  - 5 to 25 Hz, .0014 inches of peak-to-peak amplitude
  - 25 to 55 Hz, .0007 inches of peak-to-peak amplitude
  - 55 to 300 Hz, .36 inches of peak-to-peak amplitude
- Nonoperating
  - 5 to 25 Hz, .008 inches of peak-to-peak amplitude
  - 25 to 55 Hz, .004 inches of peak-to-peak amplitude
  - 55 to 300 Hz, 2 g's of force

Systems containing Winchester hard disk drives:
- Operating
  - 1 g of force
- Nonoperating
  - 20 g's of force

012B, 012C, and 012CX memory boards, iSBC. *See* Memory
056A, 056C, and 056CX memory boards, iSBC. *See* Memory
101 memory management board, iSXM. *See* Memory management
186/51 Ethernet controller, iSBC. *See* Communication controllers
188/48 terminal controller, iSBC. *See* Communication controllers
215G Winchester hard disk controller, iSBC. *See* Disk drives and controllers
216 tape controller, iSBX. *See* Tape drives and controllers
217A tape controller, iSBX. *See* Tape drives and controllers
218A flexible diskette controller, iSBX. *See* Disk drives and controllers
220 SMD drive controller, iSBC. *See* Disk drives and controllers
286/10 single board computer, iSBC. *See* Processor boards
286-Based systems. *See* Preconfigured systems, Processor boards
304 RAM expansion MULTIMODULE board, iSBC. *See* Memory
309 memory management MULTIMODULE board, iSBC. *See* Memory management
337 numeric data processor, iSBC. *See* Floating-point math
341 MULTIMODULE memory board, iSBC. *See* Memory
351 programmable serial I/O MULTIMODULE board, iSBX. *See* Communication controllers
534 four-channel communications board, iSBC. *See* Communication controllers
544 intelligent communication controller, iSBC. *See* Communication controllers
550 Ethernet controller, iSBC. *See* Communication controllers
86/30 single board computer, iSBC. *See* Processor boards
86-Based systes. *See* Preconfigured systems, Processor boards
88/45 advanced data communication processor, iSBC. *See* Communication controllers

AC current,
  fuse ratings, 5-1, 5-3
  in preconfigured systems, 2-2, 2-3
  origin, 2-5
AC power panel, 2-2, 2-3, 5-1
Addressing, 3-6, 4-6

Back panel, 2-1, 2-3, 3-2, 5-1, 5-4, 5-7
Backplane,
  function of, 2-4, 2-5
  jumpers, 3-7, 5-9, 5-10, 5-11
  size, 3-2.
    See also Cardcage
BCLK (Bus Clock), 3-7
Block diagram, 1-1, 1-2. 1-3
Board placement, 3-7
Bus access priority, 2-5, 3-6, 3-7, 5-10, 5-11
Bus contention. *See* Bus access priority
Bus master boards. *See* Bus access priority

Cable installation, 5-4, 5-5, 5-6, 5-7

Cardcage,
function of, 2-5
priority of slots, 3-7
safety, 2-3
size, 3-2
unused slots, 1-3, 1-4.
See also Backplane, Bus access priority
Chassis, hardware in, 1-5, 2-1, 2-3, 3-1. *See also* Preconfigured systems
Circuit boards, 1-5, 3-2, 4-1
Communication controllers, 2-1, 4-6, 4-7. *See also* Individual boards by number
Configuration-specific hardware. *See* Preconfigured systems
Connectors, 1-5, 2-1, 3-2, 5-5
Cover installation and removal, 5-8, 5-9

DC power,
consumption by products, 3-3, 3-4, 3-5
consumption by systems, 3-5
maximum current, 3-2, 3-3
origins, 2-5
Disk drives and controllers,
board placement and priority, 3-7, 4-4
data separator and scrambler boards, 4-4
DMA, 4-4
in preconfigured systems, 1-3, 1-4, 4-4
interrupts, 3-6, 4-4
location and size, 3-1.
See also Individual boards by number
DMA, 4-4. *See also* Disk drives and controllers

Expansion boards, 1-3, 3-2, 4-2, 4-3. *See also* Individual boards by number, Preconfigured systems

FAE. *See* Field Application Engineer
Fans, 2-3, 2-4
Field Application Engineer (FAE), 1-5, 4-2
Firmware, 4-2, 4-4, 4-5
Floating-point math. 4-3.
See also Individual boards by number
Fuses, 2-2, 5-1, 5-2, 5-3

Hardware modules. *See* Block diagram

iLBX bus, 1-3, 1-4, 3-2, 4-2, 4-5, 4-6
Interrupts, 2-5, 3-6, 4-4, 5-9
I/O interfaces, 1-3, 1-4, 4-7
iRMX operating system.
See Operating systems
iSBC. *See* Individual boards by number
iSBX bus, 1-3, 4-2.
See also Individual boards by number
iSXM bus, 4-2, 4-3.
See also Individual boards by number

Jumpers,
for communication controllers, 4-7
for expansion boards, 4-2
for memory boards, 4-6
interrupt, 2-5, 3-6, 4-4, 5-9
priority, 2-5, 3-7, 5-10, 5-11

Kits, 1-5, 4-3,
Knockouts. *See* Connectors

Memory, 1-3, 1-4, 4-5, 4-6.
See also Individual boards by number, Preconfigured systems
Memory management, 4-3
MULTIBUS,
boards, 2-5, 3-2
interface, 1-3, 3-2, 3-7
specification, 3-2, 3-3
MULTIMODULE boards.
See Expansion boards

On/off switch. *See* AC power panel
Open systems, 1-1

Operating systems,
- iRMX, 4-1, 4-4, 4-5
- XENIX, 4-1, 4-4, 4-7. *See also* Software drivers

P2 connector, 3-7. *See also* Connectors
Parallel priority resolution, 3-7. *See also* Bus access priority
Power supply, 1-5, 2-5, 3-2
Preconfigured systems,
- block diagram, 1-2, 1-3
- bus access priority, 3-7
- cable connections, 5-5, 5-6
- changing the configuration, 1-5
- circuit board size, 3-2
- communication controllers, 4-7
- connectors, 3-2
- contents, 1-3, 1-4
- DC power consumption, 3-3, 3-4, 3-5
- disk drives and controllers, 3-1, 4-3, 4-4
- expansion boards, 4-2, 4-3
- fuses, 2-2
- interrupts, 2-5, 3-6, 5-9
- memory, 3-6, 4-5, 4-6
- power supply, 3-2
- priority, 3-6, 5-11
- processor boards, 1-3, 1-4, 3-7, 4-1, 4-2
- software, 4-1
- tape controllers, 4-4

Priority. *See* Bus access priority
Processor boards,
- compatibility, 4-2, 4-3
- jumper changes, 4-4, 4-6
- in preconfigured systems, 1-3, 1-4
- placement of, 3-7. *See also* Individual boards by number, Preconfigured systems

PROMs. *See* Firmware

RAM. See Memory

Software drivers, 3-6, 4-4, 4-5, 4-6. *See also* Operating systems

Tape drives and controllers, 4-4, 4-5. *See also* Individual boards by number
Top cover. *See* Cover installation and removal

Voltage selector,
- installation and removal, 5-1, 5-2, 5-3
- location, 2-2

XENIX operating system. *See* Operating systems

REQUEST FOR READER'S COMMENTS

Intel's Technical Publications Departments attempt to provide publications that meet the needs of all Intel product users. This form lets you participate directly in the publication process. Your comments will help us correct and improve our publications. Please take a few minutes to respond.

Please restrict your comments to the usability, accuracy, organization, and completeness of this publication. If you have any comments on the product that this publication describes, please contact your Intel representative. If you wish to order publications, contact the Literature Department (see page ii of this manual).

1. Please describe any errors you found in this publication (include page number).

2. Does this publication cover the information you expected or required? Please make suggestions for improvement.

3. Is this the right type of publication for your needs? Is it at the right level? What other types of publications are needed?

4. Did you have any difficulty understanding descriptions or wording? Where?

5. Please rate this publication on a scale of 1 to 5 (5 being the best rating). ______

NAME ______ DATE ______
TITLE ______
COMPANY NAME/DEPARTMENT ______
ADDRESS ______
CITY ______ STATE (COUNTRY) ______ ZIP CODE ______

Please check here if you require a written reply. ☐

WE'D LIKE YOUR COMMENTS . . .

This document is one of a series describing Intel products. Your comments on the back of this form will help us produce better manuals. Each reply will be carefully reviewed by the responsible person. All comments and suggestions become the property of Intel Corporation.

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO. 79 BEAVERTON, OR

POSTAGE WILL BE PAID BY ADDRESSEE

Intel Corporation
5200 N.E. Elam Young Pkwy.
Hillsboro, Oregon 97123

ISO-N Technical Publications

intel®
INTEL CORPORATION, 3065 Bowers Avenue, Santa Clara, California 95051 (408) 987-8080

Printed in U.S.A.